

AFTAC

Air Force Technical Applications Center

RADIONUCLIDE SITE SURVEY REPORT SACRAMENTO, CALIFORNIA (RN-70)

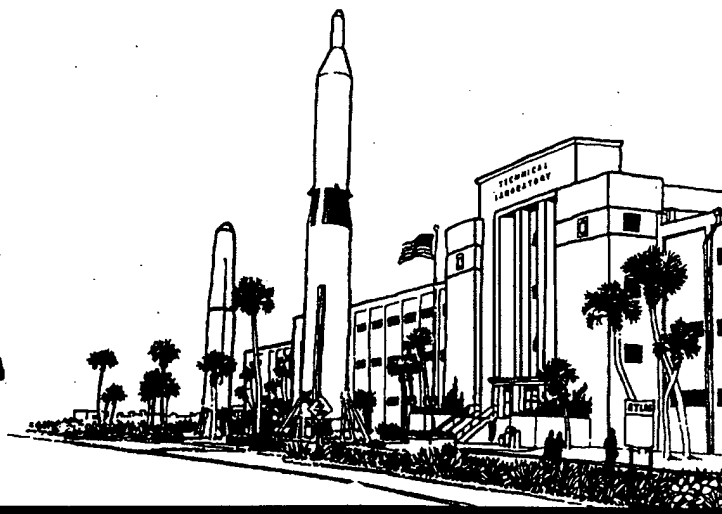
Frank Walker
John Lucas
Marv Owen
TSgt Earl Maurice McKethan
SSgt Jason Macartney

31 March 1999

Prepared for:
Provisional Technical Secretariat
Comprehensive Test Ban Treaty Organization

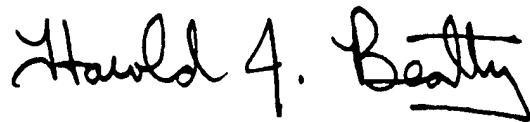
Approved for Public Release
Distribution Unlimited

DTIC QUALITY INSPECTED 4



1 9990413147

Report AFTAC-TR-99-009 has been reviewed and is approved for publication.

A handwritten signature in black ink that reads "Harold J. Beatty". The signature is written in a cursive style with a horizontal line under the last name.

HAROLD J. BEATTY, Colonel, USAF
Commander

Addressees: Please notify HQ AFTAC/TM, 1030 S. Highway A1A, Patrick Air Force Base FL 32925-3002, if there is a change in your mailing address (including an individual no longer employed by your organization) or if your organization no longer wishes to be included in the distribution of future reports of this nature.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 31 Mar 99	3. REPORT TYPE AND DATES COVERED Technical (Final)	
4. TITLE AND SUBTITLE Radionuclide Site Survey Report Sacramento, CA (RN-70)			5. FUNDING NUMBERS	
6. AUTHOR(S) Frank Walker, John Lucas, Marv Owen, Maurice McKethan, Jason Macartney (AFTAC)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Air Force Technical Applications Center (AFTAC/TM) 1030 South Highway A1A Patrick AFB, Florida 32925-3002			8. PERFORMING ORGANIZATION REPORT NUMBER AFTAC-TR-99-009	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release, distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) <p>The purpose of this report is to validate that the Sacramento, CA, site will fulfill treaty requirements as set forth by the Preparatory Commission for the Comprehensive Test Ban Treaty Organization.</p> <p>The team performing the site survey followed accepted scientific methods in collecting air and soil samples near the proposed site. The samples were analyzed by the McClellan Central Laboratory and the results forwarded to AFTAC/TM for review. The team included meteorological and technical staff. Possible sources of radionuclides were examined, as well as meteorological conditions that might affect the validity of recorded data at the site. All necessary background information required by the Commission was researched and is included in the report.</p> <p>The analysis of the samples identifies all radionuclide isotopes and their sources that might affect future samples at the site. There are no significant findings that would prevent this site from meeting treaty requirements.</p>				
14. SUBJECT TERMS AFTAC-TR-99-009 Radionuclide Site Survey Report, Sacramento, CA (RN-70) CTBT			15. NUMBER OF PAGES 50	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

This page intentionally left blank

TABLE OF CONTENTS

<i>List of Figures</i>	v
<i>List of Tables</i>	vi
<i>Introduction</i>	1
<i>Site Survey Guidance</i>	1
<i>1. General Information</i>	1
<i>2. Narrative Site Description</i>	2
<i>3. Available Buildings and Land for Hosting the Radionuclide Station</i>	2
<i>4. Operational Information</i>	2
<i>5. Existing Station Infrastructure</i>	3
<i>6. Installing Preferences for Upgrading or for a New Station</i>	3
<i>7. Meteorological Information</i>	3
<i>8. Safety</i>	5
<i>9. Environmental Issues</i>	5
<i>10. Radiological Information</i>	5
<i>11. Schedule and Measurements</i>	7
<i>12. Observations, Reasonings, Discussion, and Recommendations</i>	9
<i>Annex A: Local and General Siting Maps of Sacramento, California</i>	11
<i>Annex B: Site Photographs</i>	13
<i>Annex C: Annual Meteorological Graphs</i>	17
<i>Annex D: Decoupling Report</i>	19
<i>Annex E: Local Weather Conditions</i>	21
<i>Annex F: Experimental Air Sampler Raw Data</i>	23
<i>Annex G: Airborne Radionuclide Concentration Annual Graphs</i>	25
<i>Annex H: Topographic Map</i>	27
<i>Annex I: Tectonic Area Map</i>	29
<i>Annex J: Hazard Maps of Sacramento, California, Region</i>	31
<i>Annex K: Airborne Gamma Spectrometry Map</i>	33
<i>Annex L: Equipment Used During Site Survey</i>	35
<i>Annex M: Equipment Used for Air Sampling and Soil/Rock Samples</i>	37
<i>Annex N: Daily Activity Log</i>	39

Annex O: Personnel List _____ **41**

Distribution List: _____ **43**

List of Figures

Figure 1: Aerosol Sample Isotope Weighted Mean Concentration Summary Graph_	8
Figure 2: Soil Sample Isotope Weighted Mean Concentration Graph _____	9
Figure A-1: General Area Map of Sacramento California _____	11
Figure A-2: Local Area Site Map _____	12
Figure A-3: Site Map _____	12
Figure B-1: View from Site to North _____	13
Figure B-2: View from Site to East _____	14
Figure B-3: View from Site to South _____	15
Figure B-4: View from Site to West _____	16
Figure C-1: Annual Wind Speed Graph _____	17
Figure C-2: Annual Temperature Graph _____	17
Figure C-3: Annual Precipitation Graph _____	18
Figure H-1: Topographic Map of Sacramento Area _____	27
Figure I-1: Tectonic Map of Western United States _____	29
Figure J-1: Earthquake Hazard Map of California _____	31
Figure M-1: Soil Sample Site Map _____	37

List of Tables

<i>Table 1: Local Airports</i>	<i>1</i>
<i>Table 2: Natural Hazards</i>	<i>5</i>
<i>Table 3: Nearby Nuclear Power Plants</i>	<i>6</i>
<i>Table 4: Nearby Non-Power Nuclear Plants</i>	<i>6</i>
<i>Table 5: Summary of Aerosol Sample Weighted Mean Concentrations</i>	<i>7</i>
<i>Table 6: Soil Sample Isotope Measurements</i>	<i>8</i>
<i>Table 7: Soil Sample Isotope Weighted Error Concentrations</i>	<i>9</i>
<i>Table D-1: Decoupling Frequency of Occurrence</i>	<i>19</i>
<i>Table E-1: Meteorological Data Summary of Local Conditions</i>	<i>21</i>
<i>Table F-1: Aerosol Sample Collection/Measurement Information</i>	<i>23</i>
<i>Table F-2: Additional Aerosol Concentration Data</i>	<i>23</i>

RADIONUCLIDE SITE SURVEY REPORT

RN-70

Introduction

Sacramento, California, USA, is listed in the Comprehensive Test Ban Treaty (CTBT) as the location for an International Monitoring System (IMS) radionuclide detection system. This site is located at Camp Kohler, a part of McClellan Air Force Base (AFB) in Sacramento, California, which is scheduled to become a Federal Aviation Administration (FAA) facility after base closure. The purpose of this report is to validate that the Sacramento site will fulfill the requirements for treaty compliance.

Site Survey Guidance

The format and content of this report are based on guidance provided by the Preparatory Commission for the CTBT Organization for conducting and documenting radionuclide site surveys (see CTBT/PC/IV/WGB/1, "Requirements of Site Surveys for Radionuclide Stations," (30 September 1997).

1. General Information

- a. **CTBT Location Coordinates:** 38.70°N/121.40°W
- b. **Proposed Location:** 38°40'23.6"N/121°21'42.6"W
- c. **Altitude:** The site is located at 60 meters (m) Mean Sea Level (MSL).
- d. **Locality:** The site is located on US Government (USAF/FAA) property in the city of Sacramento, in Sacramento County.
- e. **Province:** California, USA
- f. **Airports:** One commercial and one military airport provide local access to the site, as shown in Table 1 below. McClellan AFB is scheduled for closure within the next year; disposition of the airfield is still to be determined. Distances to the site are in kilometers (km).

Table 1: Local Airports

Airfield	Distance from Site	Direction from Site
Sacramento International	18 km	west
McClellan AFB	2 km	west

g. **Seaports:** Sacramento has a seaport on the Sacramento River within 20 km of the site.

h. **Rail Station:** There is a rail station in Sacramento within 20 km southwest of the site. A rail line runs within 2 km of the site.

i. **Local Access:** Interstate Highway 80 is approximately 5 km southeast of the site. Numerous state roads surround the station and provide access from any direction.

j. **Best and most cost effective way for transporting heavy equipment:** The most cost-effective way for transporting heavy equipment is by commercial highway carrier.

k. Best and most cost effective way for people to access the station location: The most cost-effective method for people to access the site is either by commercial aircraft or by private auto.

l. Description: The site is on a flat plain surrounded by gently rolling hills. The climate can be described as semi-arid.

m. Type of terrain: The site is located on a flat parking area east of and adjacent to Building 4004 on the Camp Kohler complex. The area is surrounded by residential areas on gently rolling terrain.

n. Located in valley/depression: The site is not located in a valley.

o. Grade: N/A

p. Person in charge of the site survey:

(1) Name: Vance Hawley

(2) Organization: AFTAC

(3) Address: 1030 S. Highway A1A, Patrick AFB, Florida 32925-3002

(4) Phone: (407) 494-1413

(5) Fax: (407) 494-1417

(6) E-mail: vhawley@aftac.gov

2. Narrative Site Description

The site is located within the boundaries of Camp Kohler, which is part of McClellan AFB. This part of the base will close in April 1999 and eventually be taken over by the FAA. The shelter will be located adjacent to Building 4004, on the edge of the parking lot east of the building. The equipment will be housed in a concrete pre-fabricated shelter manufactured by Rohn, Inc., of Bessemer, Alabama. The equipment site is surrounded by a chain link fence, and the entire area is surrounded by a three-strand barbed wire fence. The FAA plans to install a 12 foot-high chain link fence when it assumes control of the facilities. Adequate power and communications already exist at the site.

3. Available Buildings and Land for Hosting the Radionuclide Station

The pre-fabricated building and the land on which it will be located are US Government-owned.

4. Operational Information

a. Responsible Agency: Air Force Technical Applications Center (AFTAC)

b. Address: 1030 S. Highway A1A, Patrick AFB, Florida 32925-3002

c. Technical contact:

(1) Name: John Lucas

(2) Address: AFTAC, 1030 S. Highway A1A, Patrick AFB, Florida 32925-3002

(3) Phone: (407) 494-7594

(4) Fax: (407) 494-5460

(5) E-mail: johnl@aftac.gov

d. Is the site shared with other organizations or used for additional purposes?

The building housing the sampler equipment will not be used by any other organization or for any other purpose.

e. Spare parts availability:

(1) Spares at site: There are no spares located at the site.

(2) Time to replace parts: DME Corporation of Orlando, Florida, is the manufacturer/maintenance contractor. The contract calls for replacement of defective equipment within 72 hours.

5. Existing Station Infrastructure

This is a new station. No prior infrastructure existed prior to the site survey and subsequent equipment installation.

6. Installing Preferences for Upgrading or for a New Station

a. Type of operation: The proposed station will be an automated operation.

b. Type of system:

(1) **Air sampler:** The proposed station will employ a Radionuclide Aerosol Sampler/Analyzer (RSA) manufactured by DME Corporation.

(2) **Measuring system:**

(a) **Detector:** The detector is a high purity Germanium detector.

(b) **Electronic:** The electronics package is a DSPEC digital spectrometer manufactured by EG&G.

(c) **Software:** The software is US Government-provided software.

c. Preferences or needs concerning the housing of the station: There are no other needs concerning the housing of the site.

d. Other preferences: None

7. Meteorological Information

a. General climate description: Sacramento and the lower Sacramento Valley have a mild climate with abundant sunshine most of the year. The sky is cloudless throughout the summer and much of the spring and fall. The summers are usually dry, with warm to hot afternoons and mostly mild nights. The rainy season is normally November through March. About 75 percent of the annual precipitation occurs during this time frame; however, measurable rain falls only about nine days a month during this period. The shielding effects of mountains to the north, east, and west usually modify winter storms. The Sierra Nevada snow fields, only 100 km east of Sacramento, provide an adequate water supply during the dry season. Heavy snowfall and torrential rains frequently fall on the western Sierra slopes and may produce flooding along the Sacramento River and its tributaries. In the valley, however, excessive rainfall as well as damaging winds are rare.

The prevailing wind at Sacramento is southwesterly every month except November, when it is northerly. Topographic effects, the north-south alignment of the valley, the Coast Range, and the Sierra Nevada Range strongly influence the wind flow in the valley. A sea level gap in the Coast Range permits cool, oceanic air to occasionally flow into the valley during the summer season. This effect is marked by a significant lowering of temperatures throughout the Sacramento-San Joaquin Delta. In the spring and fall, a large north to south pressure gradient develops over the northern part of the state. Air flowing over the Siskiyou Mountains to the north warms and dries as it descends to the valley floor. This gusty north wind is a variation of the Chinook.

Thunderstorms are few in number, usually mild, and occur mainly in the spring. An occasional thunderstorm may drift over the valley from the Sierra Nevada in the summer. Snowfalls are so rare that they may be disregarded as a climatic feature. Heavy fog occurs mostly in midwinter, never in summer, and seldom in spring or autumn. An occasional winter fog, under stagnant atmospheric conditions, may continue for several days. Light and moderate fogs are more frequent, and may come at any time during the cool, wet season. The fog is the radiation cooling type, and is usually confined to the early morning hours.

b. Average annual rainfall: The average annual rainfall is 44.2 centimeters (cm).

c. Maximum rain precipitation per 24 hours: The maximum rain precipitation in 24 hours was 9.65 cm and was recorded in the month of October.

d. Snowfall: Snowfall occurs only in trace amounts from December through April. The maximum recorded snowfall was 2 cm recorded in the month of February.

e. Prevailing wind direction: The prevailing wind direction is from the southwest.

f. Maximum wind speed: The maximum observed wind speed is 49 knots recorded in the month of November.

g. Min/Max temperature and annual average temperature: The minimum recorded temperature is -8°C , which occurred in the month of December. The maximum recorded temperature was 46°C , which occurred in the months of June and July. The mean annual temperature is 16°C .

h. Nearby large bodies of water: The Pacific Ocean is 150 km due west of the site, while Lake Tahoe is 150 km northeast.

i. Nearby mountain ranges: The Sierra Nevada Range is within 90 km east of the proposed site. The Coastal Range is within 80 km west of the site.

j. Nearby population centers: The site is located within the city of Sacramento which has a population of 1.5 million.

k. Industrial pollution: The industrial pollution is indexed as 50 out of 500 on the Environmental Protection Agency (EPA) Pollution Standards Index (PSI). A level at or below 100 indicates that a pollutant reading is in the satisfactory range. The pollutants indexed by the PSI are called "criteria pollutants." They are pollutants for which science-based health criteria are used to determine the allowable ambient (outdoor) air concentrations. The EPA regulates the criteria pollutants because of their impact on human health and the environment. They are:

Carbon monoxide (CO)
Ground-level ozone (O_3)
Lead (Pb)
Nitrogen dioxide (NO_2)
Particulate matter (PM_{10})
Sulfur dioxide (SO_2)

The standards or allowable concentrations for these six pollutants are known as National Ambient Air Quality Standards (NAAQS).

The main pollutants measured were carbon monoxide, ground level ozone, and particulate matter.

l. Nearby weather station: The nearest weather station is a National Weather Service station within 5 km of the site.

m. Person or institution that provided meteorological report:

- (1) Name: SSgt Jason Macartney, Staff Meteorologist, AFTAC/TMSW
- (2) Address: 1030 S. Highway A1A, Patrick AFB, Florida 32925-3002
- (3) Phone: (407) 494-7933
- (4) Fax: (407) 494-5450

n. Date of this report: 15 August 1998

o. Description of local microclimate situation: The local microclimate can be described as a semi-arid plain.

p. Recency of above data: The meteorological data used hourly recordings from January 1947 through December 1991. The pollution data were measured from January 1997 through December 1997.

8. Safety

a. Natural hazards: The natural hazards in Table 2 reflect the associated risk level to the station (risk level: non-existent, very low, medium, high, very high). Hazard maps, depicting medium-risk level or higher hazards are shown in Annex J, if available.

Table 2: Natural Hazards

Hazard	Risk level	Hazard	Risk level
Hurricane	very low	Landslide	medium
Tornado	very low	Volcanic activity	non-existent
Tsunami	non-existent	Animals	very low
Flood	medium	Other	none
Earthquake	high		

b. Description and possible countermeasures:

(1) **Potential safety issues on human activities in the surrounding areas:** The area surrounding the site is a residential area. The FAA plans to erect a new fence which will reduce the potential for vandalism. The new fence will also eliminate any safety risks to children who use this area as a short-cut between their residential area and school.

(2) **Potential terrain issues:** There are no other terrain issues concerning the site.

9. Environmental issues

There are no other environmental issues.

10. Radiological Information

a. Average and seasonal range of Pb-212 airborne concentration (mBq./m³):

The weighted average Pb-212 concentration was 7.90 mBq./m³. Insufficient data exist to provide seasonal range information. The average readings were based on daily measurements for 6 days in September 1995 as shown in Table 5.

b. Average and seasonal range of Be-7 airborne concentration (mBq./m³): The

weighted average Be-7 concentration was 1.46 mBq./m³. Insufficient data exist to provide seasonal range information. The average readings were based on daily measurements for 6 days in September 1995 as shown in Table 5.

c. Average and seasonal range of Cs-137 airborne concentration (mBq./m³):

The weighted average Cs-137 concentration was 0.01 mBq./m³. Insufficient data exist to provide seasonal range information. The average readings were based on daily measurements for 6 days in September 1995 as shown in Table 5.

d. Average and seasonal range of Pb-210 airborne concentration (μBq./m³):

No Pb-210 data were available.

e. Nearby nuclear power plants: The nuclear power plants shown below in Table 3 are within 700 km of the site. Rancho Seco, a decommissioned power plant 10 km south of Sacramento, still has nuclear fuel present.

Table 3: Nearby Nuclear Power Plants

Plant name	Type of reactor	Distance from site	Direction from site
WPPSS Unit 2	Boiling Water Reactor (BWR)	700 km	north
San Onofre Unit 2	Pressurized Water Reactor (PWR)	605 km	southeast
San Onofre Unit 3	Pressurized Water Reactor (PWR)	605 km	southeast
Diablo Canyon Unit 2	Pressurized Water Reactor (PWR)	370 km	south
Diablo Canyon Unit 3	Pressurized Water Reactor (PWR)	370 km	south
Rancho Seco (Decommissioned 1989)	Pressurized Water Reactor (PWR)	10 km	south

f. Nearby plants where radioisotopes are used or produced: The Nuclear Non-power Reactors located within the state of California are shown in Table 4.

Table 4: Nearby Non-power Nuclear Plants

Plant name	Type of reactor	Distance from site	Direction from site
Aero Test, San Ramon, CA	Triga (Industrial)	100 km	southwest
General Atomics, San Diego, CA	Triga Mark I	750 km	southeast
General Electric Pleasanton, CA	Nuclear Test	105 km	southwest
University of California at Irvine, Irvine, CA	Triga Mark I	650 km	southeast
University of California (on McClellan AFB)	Triga	2 km	west

g. Other natural and/or anthropogenic radionuclides: Other natural and/or anthropogenic isotopes that were measured are shown in Table 5 and Figure 1.

h. Constant and episodic anthropogenic sources of radionuclides: In the soil samples, Cs-137, Bi-212, Ra-224, and Ac-228 were found in some of the samples after not being detected in the corresponding background. Of all of these, Cs-137 is the only one not part of a natural process or a natural decay chain. The remainder of the isotopes observed were simply present in the air or soil samples in higher concentrations than what occurs in the counting room background. These isotopes (K-40, Bi-211, Bi-212, Pb-212, Bi-214, Pb-214, Th-228, Th-231, Th-234, and U-235) are naturally occurring

and/or are part of the natural decay chains. The Cs-137 is likely a remnant of the Chernobyl accident and atmospheric nuclear testing.

i. Other potential man-made radioactive sources: There are seven hospitals in the Sacramento area within 25 km of the site that may produce radioactive isotopes that will affect the RASA data. In addition, there are numerous oncology and magnetic resonance imagery clinics within 25 km of the site that may also produce radioactive isotopes. The neutron reactor in a hanger on McClellan AFB was present during air sampling and did not affect the samples. This reactor is being turned over to the University of California after base closure, and will remain in its present location.

j. Elevated natural radiation sources: No other known natural radiation sources were observed.

k. Other: N/A

l. Recency of above data: 1 February 1999

11. Schedule and Measurements

a. Period of the on-site survey: The air filter data were taken from historical data from a prototype RASA at McClellan AFB. Air samples were taken during the period of 3-10 September 1995. Additional cumulative data from 90 other samples, from October 1995 through January 1996, were also provided in Annex F. Soil samples were taken on 13 October 1998. Current GPS coordinates and site photos were taken on 1-5 March 1999.

b. Dose rate measurements: Not applicable

c. In situ gamma spectrometry: Not applicable

d. Aerosol filter measurement: The aerosol sample concentration measurements shown in Table 5 and Figure 1 were taken at a site located 22 km from the proposed site. However, the data still provide an accurate representation of the Sacramento area.

Table 5: Summary of Aerosol Sample Weighted Mean Concentrations

Isotope	Weighted* Average (mBq/m3)	Standard Deviation	Average % Deviation
Be-7	1.46	1.0621	4.5
K-40	1.28	0.1669	2.7
Cs-137	0.01	0.0011	23.3
Pb-212	7.90	7.2364	20.9
Pb-214	22.63	15.3394	21.5
Bi-212	44.13	37.7791	6.8
Bi-214	38.74	50.2389	13.2
U-235	0.06	0.0089	8.7

* Weighted by % Deviation

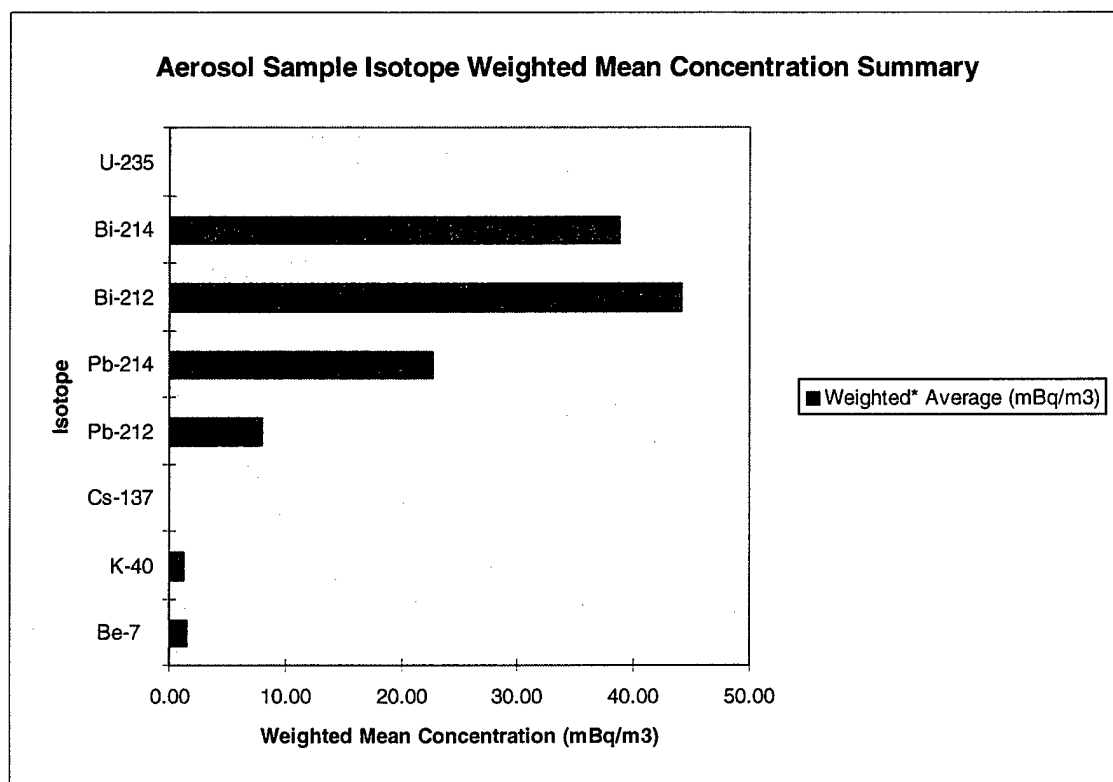


Figure 1: Aerosol Sample Isotope Weighted Mean Concentration Summary Graph

e. Soil/rock samples: Soil sample concentration measurements are shown in Tables 6 and 7 and Figure 2.

Table 6: Soil Sample Isotope Measurements

Isotope	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5		Sample 6	
	mBq/gm	% Dev	mBq/gm	% Dev	mBq/gm	% Dev	mBq/gm	% Dev	mBq/gm	% Dev	mBq/gm	% Dev
Be-7	21.92	16.4	56.06	9.3	7.98	33.7	11.73	30.5	79.70	6.8	116.15	5.3
K-40	209.82	8.0	180.00	10.1	127.14	11.4	111.58	14.1	125.99	12.0	210.39	7.6
Cs-137	1.95	23.1	3.41	17.3	3.26	15.0	1.48	33.3	1.76	24.3	10.08	7.0
Po-210											9.09	35.0
Bi-211	20.18	31.5	61.05	15.8	28.50	19.3	21.51	28.7	49.51	16.6	59.82	60.0
Bi-212	28.98	14.8	22.74	18.4	17.46	19.7	18.34	21.6	26.90	14.8	25.12	14.9
Pb-212	39.09	3.3	41.37	3.7	28.30	3.7	26.37	4.4	31.32	4.0	42.90	2.6
Bi-214	17.79	7.9	20.77	8.0	17.57	7.0	13.51	10.0	17.91	8.6	19.78	6.7
Pb-214	13.94	13.2			13.44	10.7	8.97	19.9	2.65	103.3		
Ra-224	33.77	13.5	45.26	12.9	23.93	16.1	37.71	14.8	53.89	11.9	66.62	6.7
Ac-228	45.23	3.8	37.25	5.1	26.86	6.2	29.58	5.6	32.96	5.7	35.06	5.0
Th-228	70.75	32.9	25.75	89.7	71.17	27.8			27.19	81.9	60.00	33.7
Pa-234M							151.36	44.4	75.15	75.9		
Th-234	23.33	34.8	24.77	32.6	15.96	38.6	23.34	341.2	27.23	27.0	27.37	23.6
U-235	3.79	19.2	3.65	9.9	2.72	22.2	1.97	37.4	2.34	27.3	3.75	16.6

Table 7: Soil Sample Isotope Weighted Error Concentrations

Isotope	Weighted Mean* (mBq/gm)	Standard Deviation	Average % Deviation
K-40	370.04	102.4	6.0
Cs-137	4.20	1.8	17.8
Bi-211	16.09	4.1	39.3
Bi-212	14.91	3.7	25.2
Pb-212	20.21	3.8	5.2
Bi-214	13.49	2.5	10.5
Pb-214	8.57	1.8	19.9
Ra-224	38.41	10.4	22.3
Ac-228	23.46	3.6	6.5
Th-288	45.98	11.6	42.1
Th-234	20.02	7.7	48.4
U-235	2.27	0.4	30.3

* Weighted by % Deviation

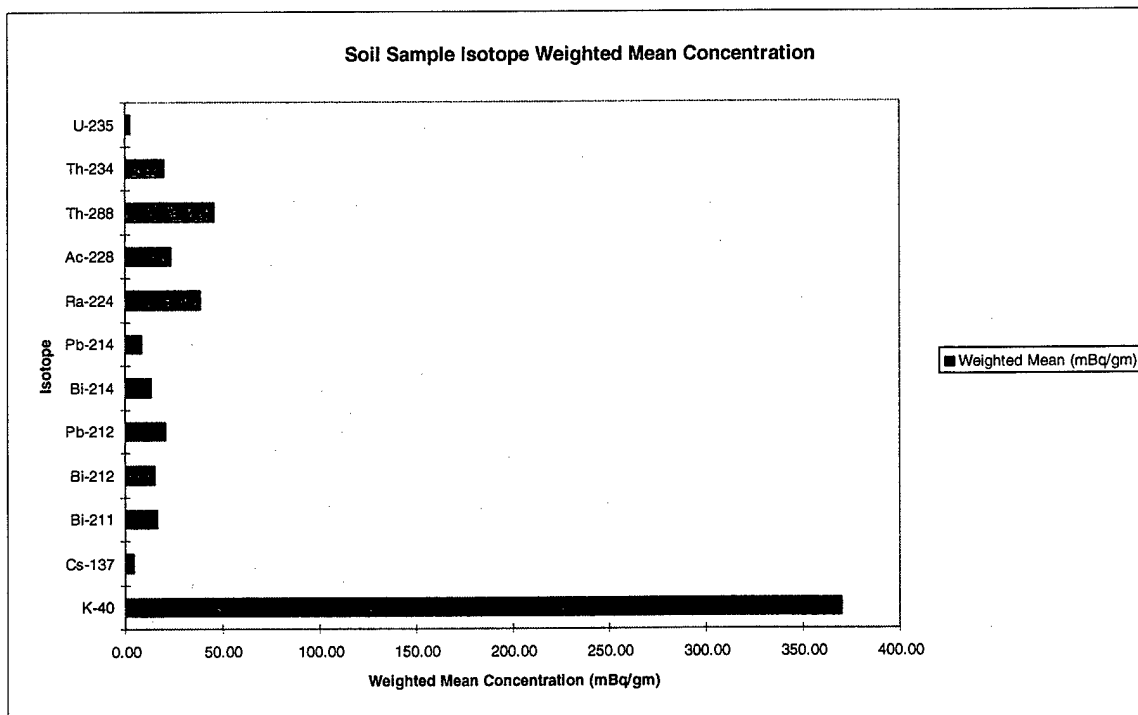


Figure 2: Soil Sample Isotope Weighted Mean Concentration Graph

12. Observations, Reasonings, Discussion, and Recommendations

a. Air flow decoupling at site: Air flow decoupling rarely occurs at the site. See Annex D for detailed decoupling data.

b. Micro climate conditions at site: The microclimate at the site is a semi-arid plain, surrounded by gently rolling terrain.

c. Infrastructure (existing/needed): There is no current infrastructure at the site.

d. Background radioactivity (natural/anthropogenic): All known natural and anthropogenic radionuclide sources have been identified and are not considered significant.

e. Communications (proposed locations of VSAT antenna, host country communication regulations, etc.): Communication is by commercial telephone line.

f. Final evaluation: This location is expected to fulfill IMS requirements.

Annex A: Local and General Siting Maps of Sacramento, CA

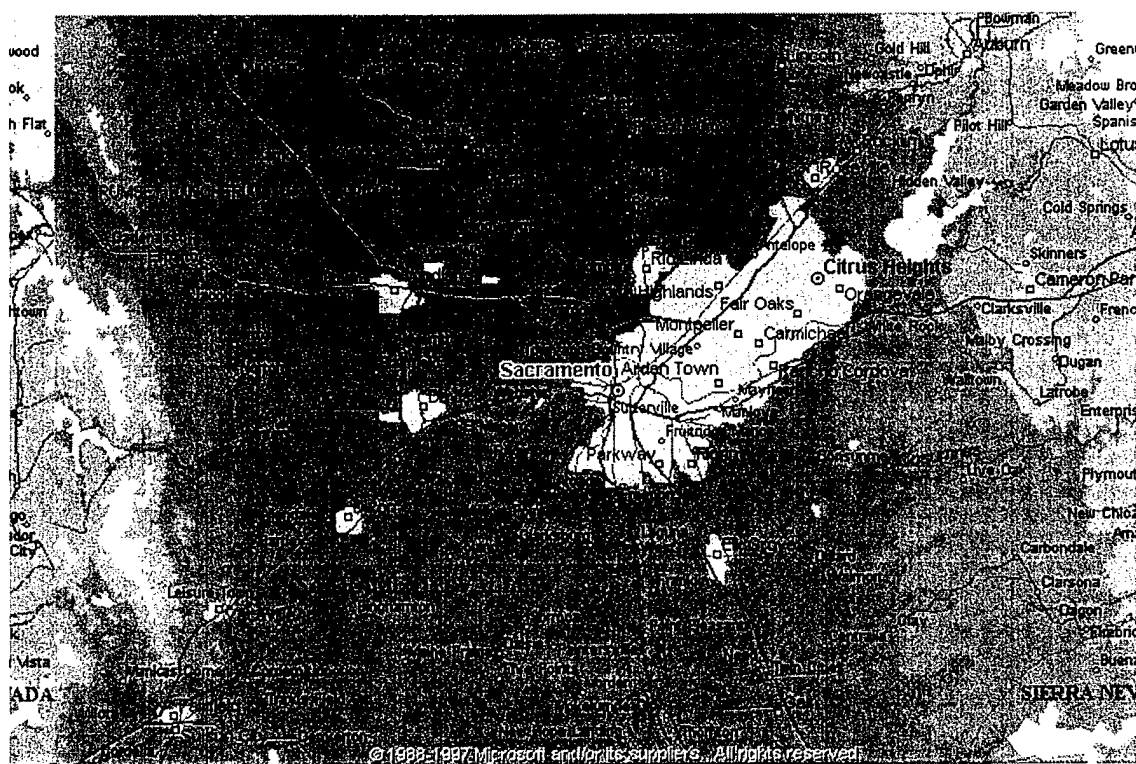


Figure A-1: General Area Map of Sacramento, California.

ANNEX A: Local and General Siting Maps of Sacramento, CA (continued)

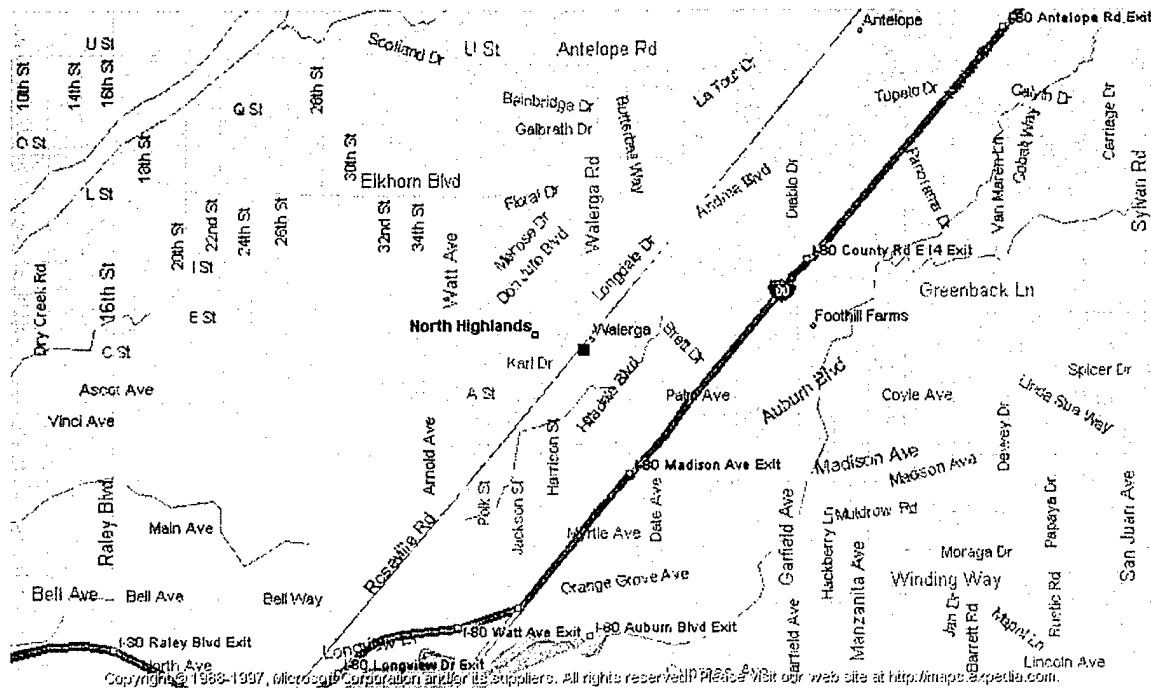


Figure A-2: Local Area Site Map

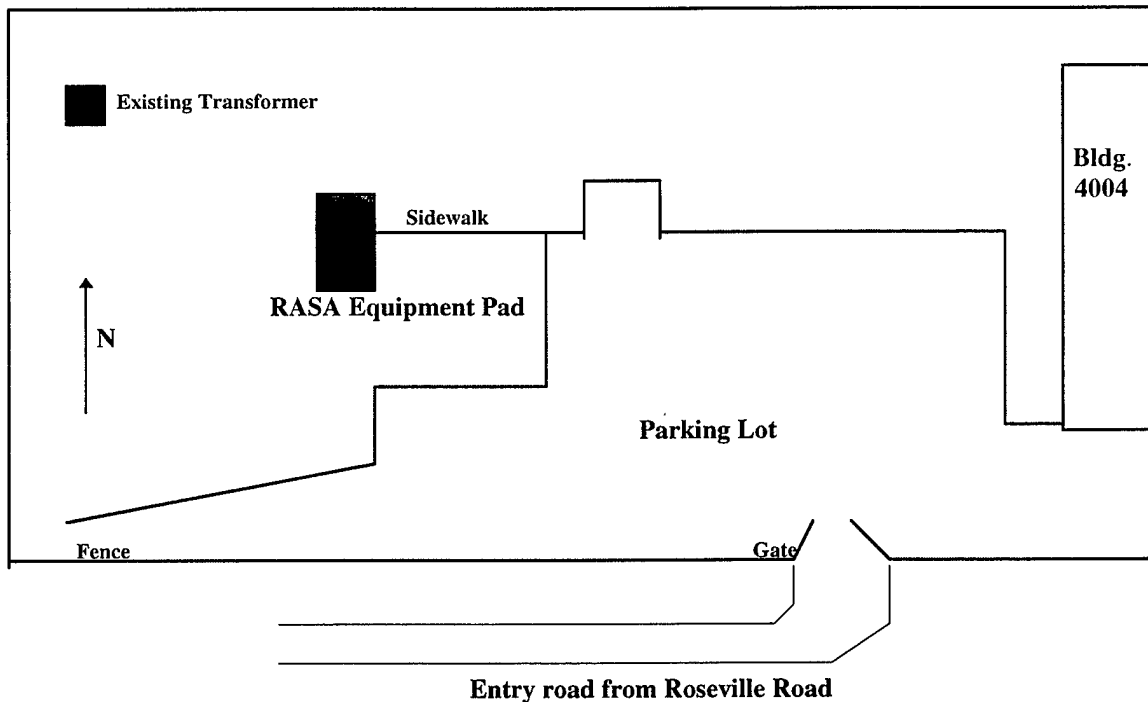


Figure A-3: Site Map

Annex B: Site Photographs

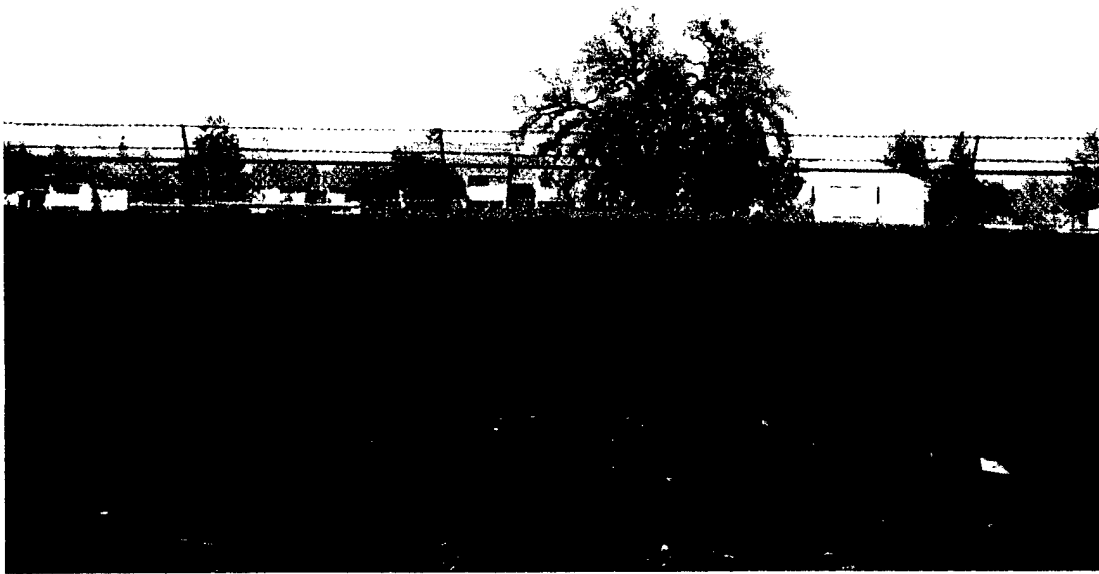


Figure B-1: View from Site to North

Annex B: Site Photographs (continued)

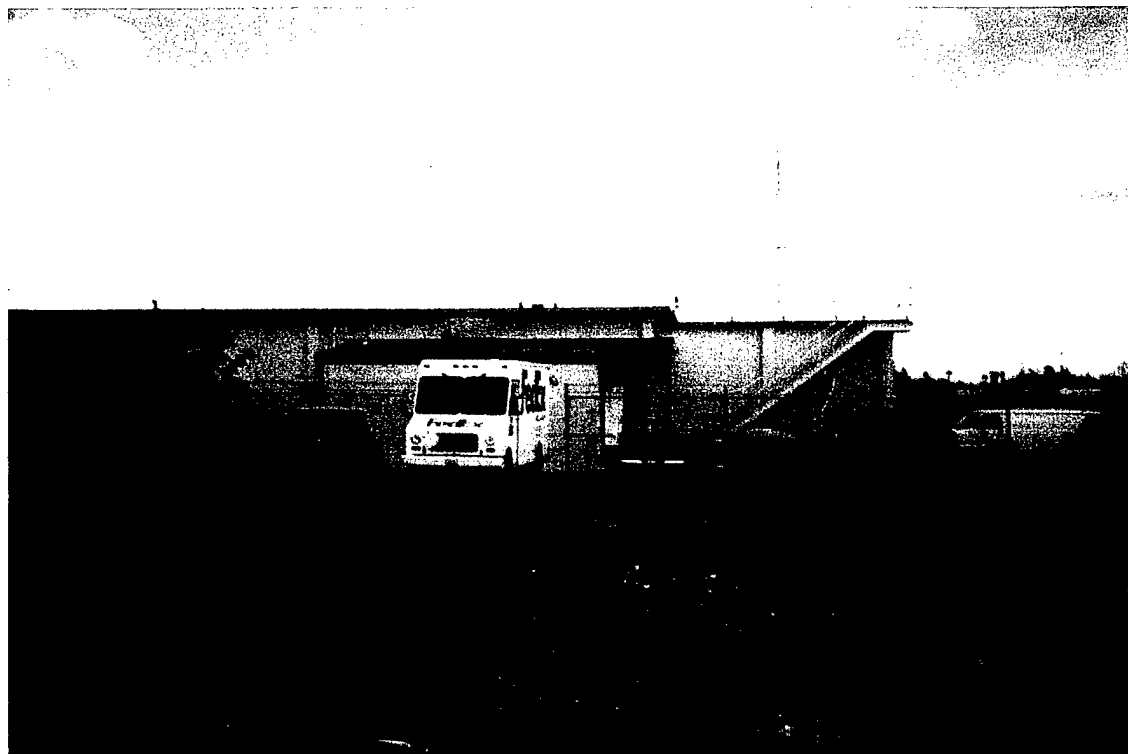


Figure B-2: View from Site to East

Annex B: Site Photographs (continued)



Figure B-3: View from Site to South

Annex B: Site Photographs (continued)



Figure B-4: View from Site to West

Annex C: Annual Meteorological Graphs

Yearly graphs of wind speed, temperature and precipitation.

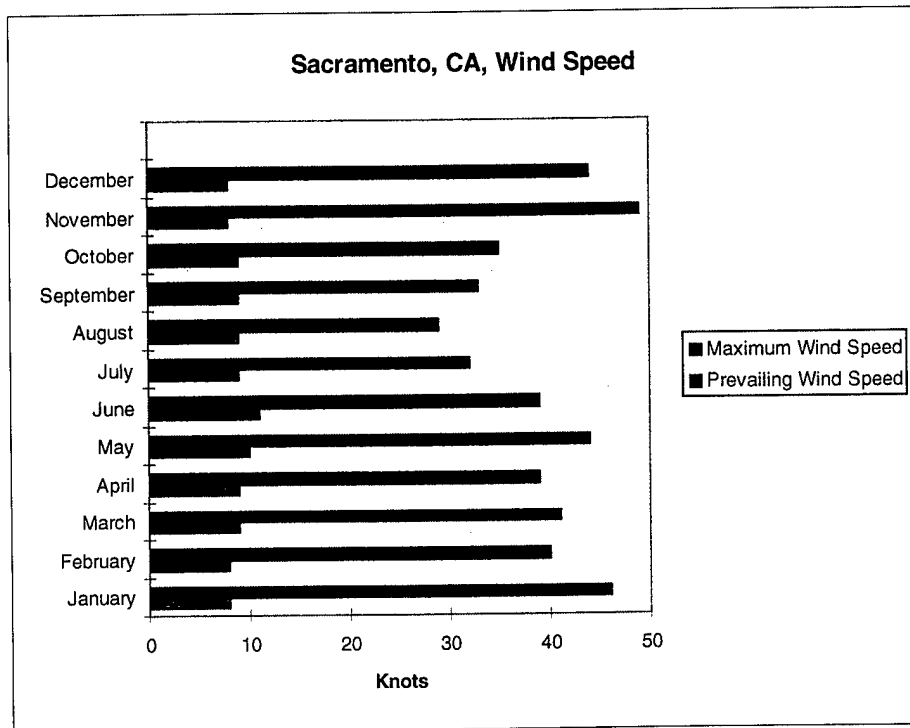


Figure C-1: Annual Wind Speed Graph

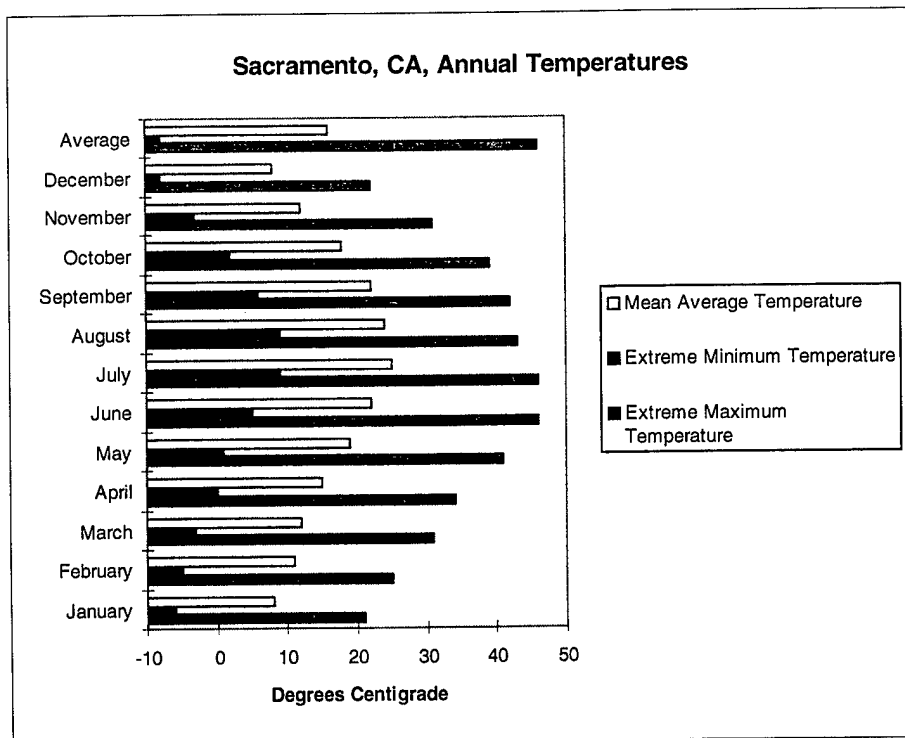


Figure C-2: Annual Temperature Graph

Annex C: Annual Meteorological Graphs (continued)

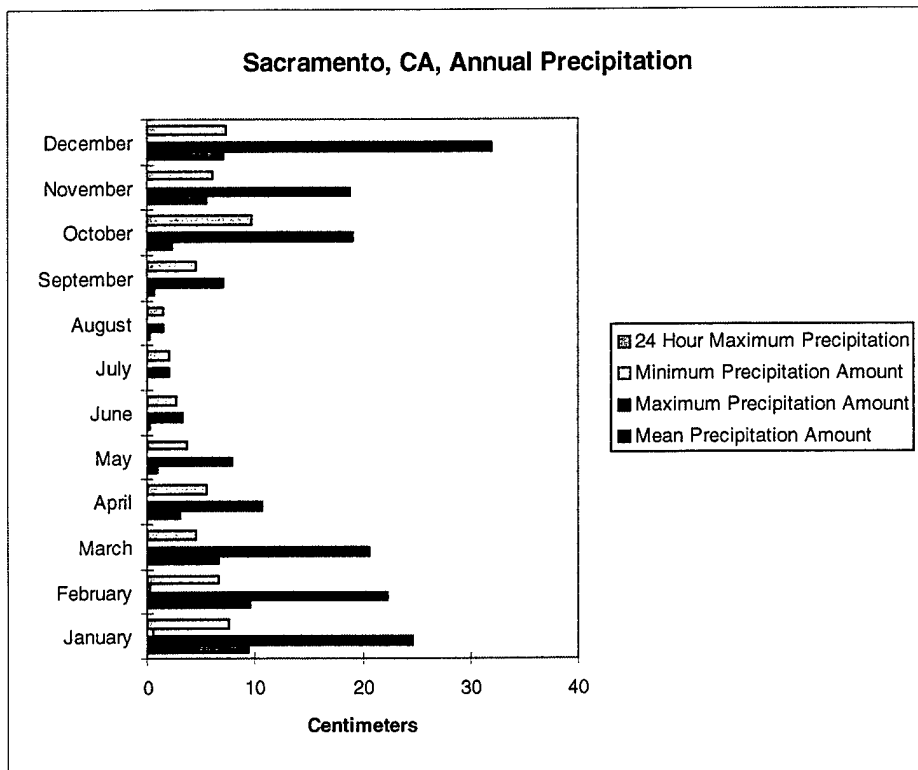


Figure C-3: Annual Precipitation Graph

Annex D: Decoupling Report

Meteorological report that attests that the site survey area is not decoupled from upper airflow for a period greater than 24 hours.

The average decoupling estimate is based on the climatological record of the Pasquill-Gifford stability classes for the site, where D is neutral, A is very unstable, and G is very stable. To estimate the site decoupling, the percentage of time the site experienced Pasquill-Gifford stability classes of F and G was summed. These are defined as stable conditions for F and extremely stable for G. The underlying assumption is that decoupling will only occur when the atmosphere is stable. These two stability classes can only occur at night, with wind speeds less than 3 m/s, and less than half the sky can have clouds. These data are based on hourly surface observations taken at each station.

The F and G conditions generally do not last for more than 2-3 hours during a specific day at Sacramento. Therefore, the Sacramento sampling site is not decoupled from the upper atmosphere for periods exceeding 24 hours.

Period of Record: 1973-1996

of Observations: 209,272

NWS McClellan AFB, CA

% Frequency of Occurrence

Stability Indices for Sacramento, California

Table D-1: Decoupling Frequency of Occurrence

Stability Index	% Freq of Occurrence	Stability Index	% Freq of Occurrence
Jan F&G	26.0%	Jul F&G	20.0%
Feb F&G	29.9%	Aug F&G	21.0%
Mar F&G	25.8%	Sep F&G	34.2%
Apr F&G	27.2%	Oct F&G	40.1%
May F&G	24.5%	Nov F&G	38.1%
Jun F&G	20.2%	Dec F&G	27.6%

This page intentionally left blank

Annex E: Local Weather Conditions

Meteorological report by experts on local weather conditions (local air flow)

44 - Year Meteorological Report (Jan 47 - Dec 91)

Met Station: NWS, McClellan AFB, CA

Table E-1: Meteorological Data Summary of Local Conditions

	Mn Max Tmp	Mn Min Tmp	Mn Avg Tmp	Ext Max Tmp	Ext Min Tmp	Mn Pcp Amt	Max Pcp Amt	Min Pcp Amt	24hr Max Pcp	Prev Wnd Dir	Prev Wnd Spd	Max Wnd Gust	Mn Snw Fall	Max Snw Fall	24hr Max Snw
Jan	12	4	8	21	-6	9.40	24.6	0.51	7.62	SE	8	46	T	T	T
Feb	16	5	11	25	-5	9.50	22.3	0.25	6.60	SE	8	40	T	2	2
Mar	18	6	12	31	-3	6.60	20.6	0.00	4.60	SW	9	41	T	T	T
Apr	22	8	15	34	0	3.05	10.6	0.00	5.60	SW	9	39	T	T	T
May	27	10	19	41	1	1.02	7.9	0.00	3.80	SW	10	44	0	0	0
Jun	31	13	22	46	5	0.25	3.3	0.00	2.79	SW	11	39	0	0	0
Jul	34	15	25	46	9	T	2.0	0.00	2.03	SSW	9	32	0	0	0
Aug	33	15	24	43	9	0.25	1.2	0.00	1.52	SSW	9	29	0	0	0
Sep	31	14	22	42	6	0.76	7.1	0.00	4.57	SSW	9	33	0	0	0
Oct	26	10	18	39	2	2.30	19.1	0.00	9.65	NW	9	35	0	0	0
Nov	18	6	12	31	-3	5.60	18.8	T	6.10	NW	8	49	0	0	0
Dec	12	4	8	22	-8	7.10	32	0.00	7.37	SE	8	44	T	T	0
Ann	24	9	16	46	-8	44.20	84.9	14.20	9.65	SW	9	49	T	2	2

Data listed in Table E-1 are measured in degrees Centigrade, centimeters of precipitation, and knots of wind speed.

This page intentionally left blank

Annex F: Experimental Air Sampler Raw Data

Table F-1: Aerosol Sample Collection/Measurement Information

Sample	Collection Start	Collection Stop	Duration (hr)	Volume (m3)	Acquisition Start	Duration (hr)
Filter 1	03-Sep-95	04-Sep-95	24	23706.28	05-Sep-95	24
Filter 2	04-Sep-95	05-Sep-95	24	23293.96	06-Sep-95	21.3
Filter 3	07-Sep-95	08-Sep-95	24	19889.54	09-Sep-95	24
Filter 4	08-Sep-95	09-Sep-95	24	17291.56	10-Sep-95	24
Filter 5	09-Sep-95	10-Sep-95	24	21277.36	11-Sep-95	24
Filter 6	10-Sep-95	11-Sep-95	24	21058.74	12-Sep-95	24
Isotope	Filter 1		Filter 2		Filter 3	
	mBq/m ³	% Dev	mBq/m ³	% Dev	mBq/m ³	% Dev
Be-7	1.10	2.2	2.60	6.8		
K-40	1.10	2.6	1.19	2.5	1.34	2.9
Cs-137	0.01	17.9	0.01	19.6	0.01	24.1
Pb-212	2.64	10.2	1.53	11.6	19.43	14.8
Pb-214	0.67	20.1	0.59	24.0	0.81	32.3
Bi-212	13.80	8.3	8.67	7.5	89.74	6.7
Bi-214			1.31	17.9	2.98	9.4
U-235	0.05	7.3	0.05	6.7	0.06	10.0
Isotope	Filter 4		Filter 5		Filter 6	
	mBq/m ³	% Dev	mBq/m ³	% Dev	mBq/m ³	% Dev
Be-7						
K-40	1.58	2.7	1.22	3.1	1.26	2.5
Cs-137	0.01	35.0	0.01	25.8	0.01	17.4
Pb-212	11.05	10.0	8.47	7.2	0.65	71.6
Pb-214	0.91	28.7	38.34	3.5	0.86	20.3
Bi-212	52.00	4.9				
Bi-214	2.77	16.6	115.00	7.3	3.66	14.9
U-235	0.07	7.3	0.06	8.8	0.06	12.1

Table F-2: Additional Aerosol Concentration Data

Additional Concentration Data		
Isotope	Concentration	Period
Be-7	~ 1.5 mBq/m ³	12 Oct 95-01 Feb 96
Pb-212	~ 40 mBq/m ³	12 Oct 95-07 Dec-96
Pb-212	~ 15 mBq/m ³	14 Dec 96-01 Feb 96
Total dataset includes 90 samples		

This page intentionally left blank

Annex G: Airborne Radionuclide Concentration Annual Graphs

Yearly graphs of radionuclide concentrations in the air.

This information was not sampled.

This page intentionally left blank

Annex H: Topographic Map

Topographic map of the Sacramento, California, area.



Figure H-1: Topographic Map of Sacramento Area

This page intentionally left blank

Annex I: Tectonic Area Map

Tectonic map of Western United States

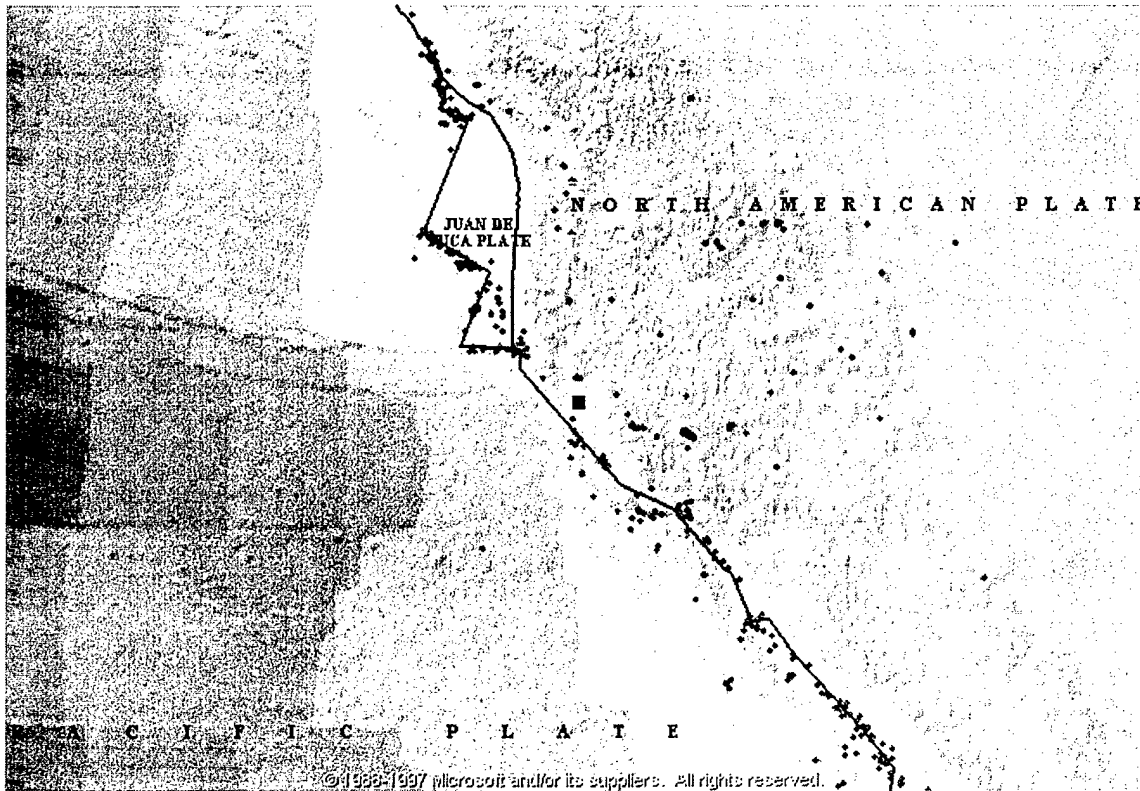


Figure I-1: Tectonic Map of Western United States

This page intentionally left blank

Annex J: Hazard Maps of Sacramento, California, Region

No flood or landslide hazard maps of the Sacramento area were available.

Figure J-1 below depicts a recent cross-section of earthquake activity in the general area of the site.

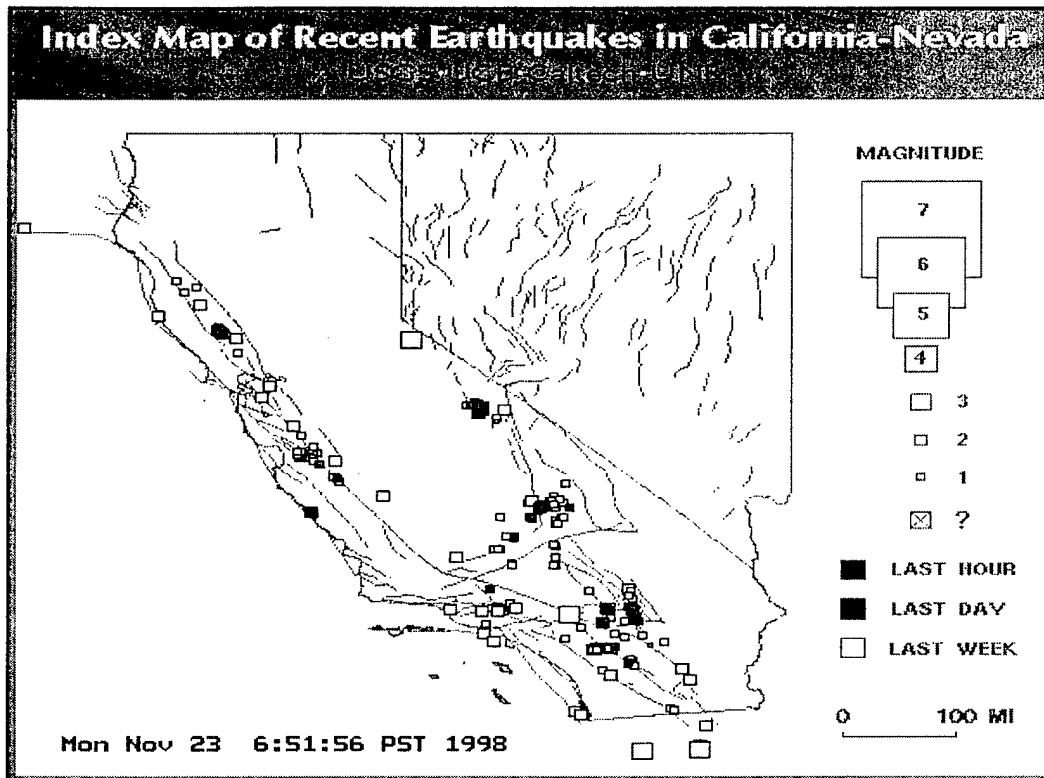


Figure J-1: Earthquake Hazard Map of California

This page intentionally left blank

Annex K: Airborne Gamma Spectrometry Map

Airborne gamma spectrometry maps

This information is not applicable.

This page intentionally left blank

Annex L: Equipment Used During Site Survey

List of equipment used (with technical specifications and manufacturer) during the site survey.

Global Positioning Satellite Receiver

Model: Garmin GPS 12XL
Certificate: FCC ID JPH-17800
Manufacturer: Garmin
Olathe, Kansas, USA

This page intentionally left blank

Annex M: Equipment Used for Air Sampling and Soil/Rock Samples

List of equipment used (with technical specifications and manufacturer) for the filter used during the on-site survey and the soil/rock samples.

Soil/Rock Samples: Four soil samples were collected from within a few hundred m of the proposed RASA sampler site. Two more samples were collected from 1-3 km from the site. These two samples were taken upwind of the site. Samples were scooped into plastic vials after loose dust was brushed away from the soil surface. About 25 cm³ of soil was contained in each vial. A map was sketched of the sample area, with all sampling sites marked (see Figure M-1). Labels were applied to each vial corresponding with sites on the sketch. Vials were then placed in a sealable plastic bag and mailed to the laboratory.

1. 38°40'23.1"N/12°21'42.6"W
2. 38°40'23.1"N/121°21'45.8"W
3. 38°40'24.0"N/121°21'45.7"W
4. 38°40'23.8"N/121°21'47.5"W
5. 38°40'56.9"N/121°21'25.6"W
6. 38°40'57.7"N/121°21'26.2"W
- Site. 38°40'23.6"N/121°21'42.6"W

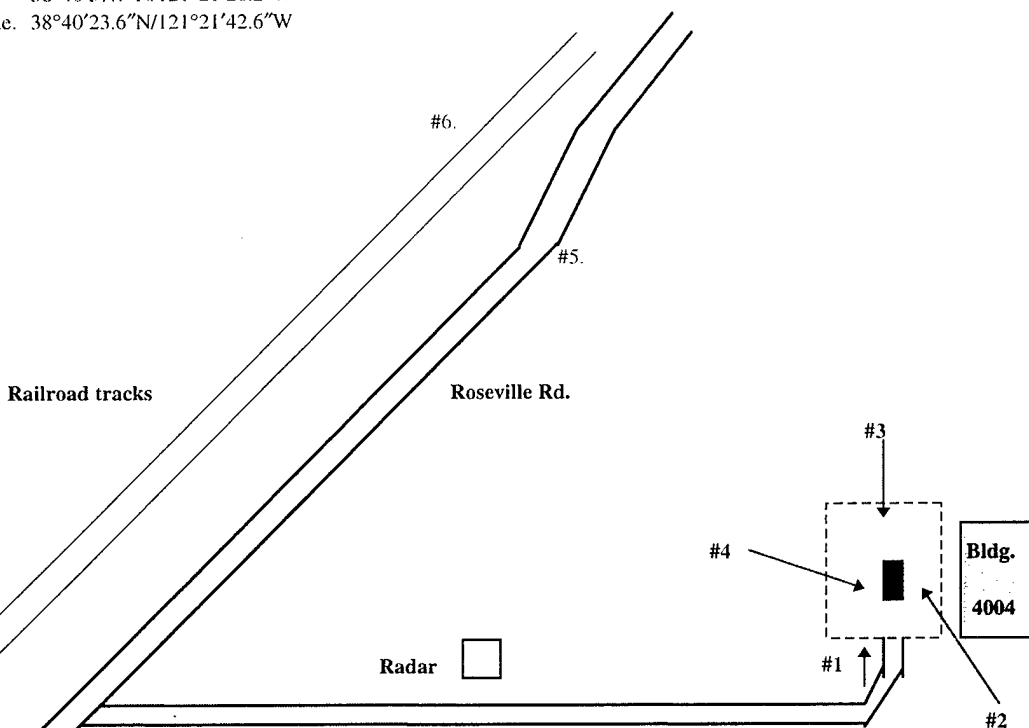


Figure M-1: Soil Sample Site Map

Annex M: Equipment Used for Air Sampling and Soil/Rock Samples (continued)

Air Samples: Air filter samples were obtained with a prototype RASA which recorded samples 22 km from the site.

Annex N: Daily Activity Log

Log of overall daily activities during the site survey.

3-10 September 1995	Air samples taken.
13 October 1998	Soil samples taken.
1-5 March 1999	GPS coordinates/Site photos taken.
1 October 1998 - 31 March 1999	Meteorological and background data compiled.
26 March 1999	Site survey report completed.

This page intentionally left blank

Annex O: Personnel List

**List of the scientific and/or technical people who participated in the survey process,
(with phone number, fax, and E-mail).**

Soil Samples

TSgt Steven Fredericks*

Tech Operations Division, McClellan AFB, CA

SSgt Andrew Austin*

Tech Operations Division, McClellan AFB, CA

*Individuals no longer at base.

GPS Coordinates/Photos

SSgt Vance Hawley (AFTAC/LG)

(407) 494-1414

Phone

(407) 494-1417

Fax

vhawley@aftac.gov

E-mail

This page intentionally left blank

Distribution List:

OSD/NTP	(2)
DTRA/OST	(1)
AFTAC/TM	(3)
AFTAC/TT	(1)
AFTAC/CAS	(1)
AFTAC/LSCLM	(6)
AFTAC/TMSW	(1)
ASC Det 3	(1)
CTI	(3)
DTIC	(1)